HARDING UNIVERSITY

Single Player Against Machine BAttleship Game

System Design and Project Plan

Matt Goodhart Timothy Hoffmann Matt Lewis Tatiana Zeledon

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System Design

Background

Battleship® is a very popular game around the world whose origin dates back to the early 1900ôs when it was invented by Clifford Von Wickler. However, he never patented the game and it was trademarked and commercially produced by the Milton Bradley Company in 1943 as a paper and pencil game. By the 1960ôs, and perhaps earlier, a player was able to purchase prepared paper sheets for the game. Since the beginning, letters were printed in the outer vertical edges of the sheet and numbers were printed horizontally at the top.

In 1967, the board game of Battleship® was created. The pencil and paper were discarded and were replaced with plastic ships, pegs, and trays. Later, in 1983, the Milton Bradley Company improved the version and included electronic components and new features such as lights and sound. In 2008, the latest version of Battleship® called ôThe Tactical Combatô was introduced and it includes several modifications to the existing version such as the shape of the ships and board. The Milton Bradley Company has being the only company to continuously produce a Battleship® game for any extended period of time.

Our motivation is to create a technically challenging, semi-automated version of the game Battleship® in order to promote the interest of future Harding students into the engineering program.

System Overview

Our goal is to create an essentially hands-free version of the classic Battleship® game. The game will be powered through a standard 110 V AC household outlet. There will be a keypad that will receive input such as accepting the coordinates of the playerôs moves. Also, there will be an LCD screen that will provide feedback to the user and will prompt the user with instructions and notifications, such as when to make a move or indicate when the player has sunk one of the computerôs ships.

Beginning game play will require the player to physically place his/her ship pieces on the lower display board. The player then indicates to the computer that this has been done, and the game begins a random selection of who (player or computer) goes first. This selection will be indicated on the LCD screen. On his/her turn, the player inputs his/her move. The microprocessor then discerns if the input was a hit or miss and gives the corresponding output on

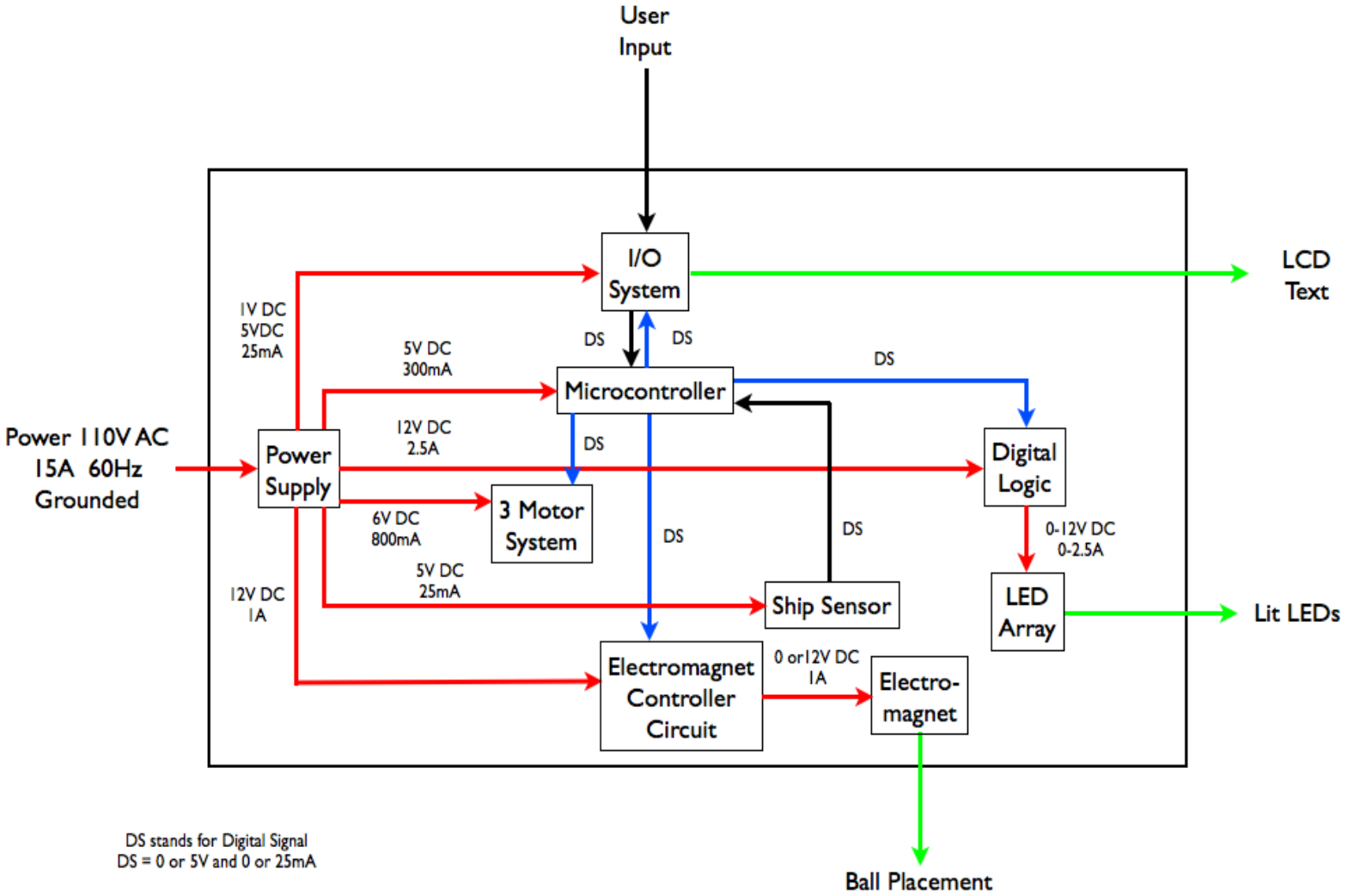
the upper display. Outputs include lighting a red LED (hit) or a green LED (miss). On the computerôs turn, a plunger/button system moves and senses whether there is a ship in that coordinate or not, and shows its output on the lower display by placing a red (hit) or green (miss) ball via the ball manipulator into the selected spot.

This process is repeated until the computer determines that all the playerôs ships have been sunk or all the computerôs ships have been sunk. Whenever one of these two scenarios takes place, the game is over. At this point, the user will see where the computerôs ships were as indicated by red LEDôs on the upper display of the board. Results will be displayed until the on/off switch is pushed. Our prototype will be delivered as a fully functional battleship game. The top half may be closed and latched so that it may be transported.

Block Diagram

Single Player Against Machine BAttleship Game

Matt Goodhart, Timothy Hoffmann, Matt Lewis, Tatiana Zeledon



Functional Description of Blocks

Module	I/0 System
Inputs	Power 5V DC and 25mA ï Keypad Power 5V DC and 25mA ï LCD for power Power 1V DC and 25mA ï LCD for contrast User Input Digital signal to LCD from microcontroller ï 0 or 5V DC and 0 or 25mA
Outputs	LCD text Digital signal from keypad to microcontroller ï 0 or 5V DC and 0 or 25mA
Functionality	The user will place his/her move by inputting it on the keypad that looks similar to the keypad on a phone. The numbers A-J will correspond to the numbers 1-10 such that 1=A, 2=B, etc. Each button will have both the number and letter printed on it. The computer will prompt the user to select a letter and the user will input a letter. The computer will then prompt the user to select a number and the user will input a number. Those two signals will be sent to the microcontroller as the userôs move. The LCD screen is the microcontrollerôs way of talking to the user and telling him/her what to do.

Module	Power Supply
Inputs	Power 110V AC Grounded
Outputs	To keypad ï 5V DC and 25mA To LCD ï 1V DC and 25mA To LCD ï 5V DC and 25mA To microprocessor ï 5V DC and 25mA To 3 motor system ï 6V DC and 800mA To electromagnet controller circuit ï 12V DC and 1A To ship sensor ï 5V DC and 25mA To digital logic ï 12V DC and 2.5A
Functionality	The power supply system receives 110V AC from the wall. It then steps down and cleans up the power before it sends it out to the appropriate module.

Module	3 Motor System
Inputs	Power 6V DC and 800mA Signal to motor from microcontroller ï 0 or 5V DC and 0 or 25mA
Outputs	Movement
Functionality	Each of the three stepper motors is responsible for moving a part of the game in a certain direction. There are three motors: the letters motor, the numbers motor, and the plunger motor. Each motor receives power from the power supply and moves as long as power is received as determined by the microcontroller. The letters motor causes the ball manipulator and plunger to move parallel to the letters. The numbers motor has the same function as the letters motor except it moves parallel to the numbers. The plunger motor is what causes the push button to raise and lower to test of the presence of a ship.

Module	Electromagnet Controller Circuit
Inputs	Power 12V DC and 1A Digital signal from microcontroller ï 0 or 5V DC and 0 or 25mA
Outputs	0 or 12V DC and 0 or 1A
Functionality	Accepts a digital signal from the microcontroller which tells the circuit whether or not to allow power to the electromagnet.

Module	Electromagnet
Inputs	Power 12 V DC and 1A Digital signal to electromagnet from electromagnet controller circuit ï 0 or 5V DC and 0 or 25mA
Outputs	Ball Placement
Functionality	When the electromagnet receives power from the electromagnet controller circuit, it attracts a ball from the ball hopper and carries that ball to the appropriate location via the motors. When the electromagnet no longer receives power, the ball drops into the hole corresponding to the computerôs move.

Module	Ship Sensor
Inputs	Power 5V DC and 200mA
Outputs	Digital signal to microcontroller ï 0 or 5V DC and 0 or 25mA
Functionality	The ship sensor is in the form of a push button. The plunger motor will lower the button down to approximately halfway between the height of the board and the height of the ship piece. If a ship is present, the button will be below the level of the ship and the button will be depressed. It will return a high signal telling the microcontroller that a ship is present and the guess is a hit. If a ship is not present, the button will not be depressed. It will continue to return a low signal telling the microcontroller that the guess is a miss.

Module	Digital Logic
Inputs	Power 0V DC and 5V DC and 200A ï for flip-flop Power 12V DC and 2.5 A Digital signal from microcontroller ï 0 or 5V DC and 0 or 25mA
Outputs	0 to 12V and 0 to 2.5A
Functionality	Accepts signals from the microcontroller and logically determines the necessary output through a series of multiplexors and latches.

Module	LED Array
Inputs	0 to 12V DC and 0 to 2.5A
Outputs	Lit LEDs
Functionality	The LED array is the physical display the user will see that displays the moves that he/she has selected. Individual LEDs receive power from the power supply that has been directed by the digital logic.

Module	Microcontroller
Inputs	Power 5 V DC and max of 300mA Digital signal from I/O System ï 0 or 5V DC and 0 or 25mA Digital signal from push button ï 0 or 5V DC and 0 or 25mA
Outputs	Digital signal to I/O System ï 0 or 5V DC and 0 or 25mA Digital signal to 3 motor system ï 0 or 5V DC and 0 or 25mA Digital signal to electromagnet controller circuit ï 0 or 5V DC and 0 or 25mA Digital signal to digital logic ï 0 or 5V DC and 0 or 25mA
Functionality	The microcontroller will store and run the program for the battleship game. This program will keep track of the game progress including storing previous computer and user moves and will calculate future moves for the computer accordingly. It will also output signals to the ball manipulator to place balls indicating the computers moves and will send signals to the digital logic of the LED system to indicate user moves. The microcontroller will also send information to the user via the LCD screen and take in information from the user via the keypad.

Project Plan

Organization and Management

Matt Lewis ï Matt Lewis is the electrical engineer of the team. He will primarily be responsible for the design and construction of SPAMBAGôs electrical components. Matt will be designing the power supply, upper (LED) display, keypad, and electromagnet. In addition to these modules, he will be responsible for the electrical integration of all parts with electrical components, which includes powering all electrically powered modules and the communication lines between the modules. He will be the secondary engineer on most of the modules of which Tim is primary engineer. While working on these modules, he will be simulating and testing them. After recording the results, he will use the results from these to better engineer those modules. After mastering how to test each of the modules, he will effectively demonstrate their performance.

Timothy Hoffmann ï Timothy Hoffmann is the computer engineer of the team with a 50/50 electrical engineering and computer science split. He will be primarily responsible for the programming of SPAMBAG and the integration of the LCD screen to the system. He will also be responsible for programming the system to send the appropriate signals to the system when necessary and will be working with Matt Lewis closely on the electrical schematics and design. He will also be responsible for writing system test programs explained in the requirements specification. He will also be responsible for contributing to system status reports, documenting progress, designing flowcharts and schematics on the microcontroller system, and participating in group presentations.

Matt Goodhart ï Matt Goodhart is a mechanical engineer and is the project leader. As project leader, Matt is responsible for overseeing all components of the project, reviewing all final documents, keeping the project on schedule, and keeping track of the budget. For the project, Matt is responsible for designing and constructing the movement system for the ball placement system and integrating that with the motors. He will do all of the calculations involved in determining the number of steps each stepper motor must go through to arrive at each coordinate. Matt is jointly responsible with Tatiana for designing and constructing the frame. He will be the secondary engineer on any modules on which Tatiana is the primary engineer. He will create CAD drawings in SolidWorks of the frame and the three motor systems. In addition to the CAD drawings, Matt will also use the MotionWorks feature of SolidWorks to show the movement ability of the frame and three motor systems.

Tatiana Zeledon ï Tatiana is a mechanical engineer. She will be working in the design and implementation of the plunger/button sensing device of the ball placement system and the fabrication of the physical ship pieces. She will also be working with Matt Goodhart in the system integration of the ball placement system and the design and construction of the frame. Tatiana will be working with the simulations and SolidWorks drawings of the overall system, parts selection and research of the mechanical parts of the project and any documentation required. She will do calculations involved in determining the number of steps the stepper motor of the button/plunger sensing device must go through to determine the presence of a ship. She will be the secondary engineer on the modules that Matt Goodhart is the primary engineer. She will also participate in group written reports and oral presentations.

Work Breakdown Structure – Fall 2009						
Task	**Activity**	**Description**	**Deliverable / Checkpoints**	**Duration**	**People**	**Resources**
F1.0	Requirements Specification	Document stating what the project will do in detail	Basic ideas of project, written document	9/13 - 9/29	M,M,T,T	Computer
F2.0	Overall System Design	Design entire project in detail	Choose best solutions and apply them	9/25 - 10/16	M,M,T,T	Computer
F3.0	I/O Design	Communicates between the user and the game	Schematic of keypad and selection of LCD screen	10/15 - 11/3	Matt L., Tim	Computer, Multisim
F3.1	Keypad Design	Takes input from the user	Schematic and sketch of keypad	10/15 - 10/30	Matt L.	Computer, Multisim
F3.2	LCD Design	Outputs Information to user	Selection of LCD & manufacturer's data sheets	10/20 - 11/3	Tim	Computer
F4.0	Microcontroller Selection	Select an appropriate microcontroller that will run the game code	Selection of microcontroller & manufacturer's data sheets	11/3 - 11/15	Tim	Computer
F5.0	LED Array Design	Displays the user's moves	Schematic of LED circuitry	10/22 - 11/15	Matt L.	Computer, Multisim
F6.0	Digital Logic Design	Determines which LEDs receive power	Schematic of digital logic	10/22 - 11/15	Matt L.	Computer, Multisim
F7.0	Power Supply Design	Supplies power to all modules of game	Schematic of power supply circuitry	10/22 – 11/3	Matt L.	Computer, Multisim
F8.0	Ball Placement Design	Displays computer's moves	SolidWorks drawings and MotionWorks simulations	10/15 - 11/15	M,M, Tatiana	Computer, SolidWorks
F8.1	Movement System Design	Moves ball to appropriate coordinates	SolidWorks drawings and MotionWorks simulations	11/1 - 11/15	Matt G.	Computer, SolidWorks
F8.2	Electromagnet Design	Magnetically picks up and drops ball	Calculations of necessary windings and current & material size and shape	10/20 - 11/5	Matt L.	Physical tests
F8.3	Electromagnet Controller Circuit	Allows power to go to the electromagnet	Schematic of electromagnet controller circuitry	10/20 - 11/5	Matt L.	Computer, Multisim
F8.4	Ship Sensor and Game Piece Design	Senses the presence of the constructed ships	Selection of push button and idea of how to lower the push button & design of game pieces	11/08 - 11/15	Tatiana	Computer
F9.0	Frame Design	Encases entire game	SolidWorks drawings and mockups	10/15 - 11/15	Matt G., Tatiana	Computer, SolidWorks

Work Breakdown Structure – Fall 2009 (continued)						
Task	**Activity**	**Description**	**Deliverable / Checkpoints**	**Duration (Weeks)**	**People**	**Resources**
F10.0	Parts Selection	Make final decision as to which parts to use	Documentation of ordered parts and data sheets of each part	9/20 - 12/8	M,M,T,T	Computer
F11.0	System Design & Project Plan	Breakdown of design and build process and detailed scheduling	Report and Presentation	9/29 - 10/15	M,M,T,T	Computer
F11.1	Report	Write detailed report regarding the above ideas	Written report	9/29 - 10/13	M,M,T,T	Computer
F11.2	Presentation	Present ideas to faculty	Power point and verbal presentation	10/4 - 10/15	M,M,T,T	Computer
F12.0	Intermediate Design Review	Finalize design of project	Report and Presentation	11/16 - 12/9	M,M,T,T	Computer
F12.1	Report	Write detailed report regarding the above ideas	Written report	11/16 - 12/9	M,M,T,T	Computer
F12.2	Presentation	Present design and analysis to faculty	Power point and verbal presentation	12/1 - 12/9	M,M,T,T	Computer
O1.0	Documentation	Keep logs of work and research	Engineering notebooks	9/13 - 12/31	M,M,T,T	Computer, Notebooks
O2.0	A3 Status Reports	Bimonthly reports on current project status	Presentation of status and current progress	9/13 - 12/10	M,M,T,T	Computer
O3.0	Time Management	Keeping to a schedule	Keeping on schedule	9/13 - 12/10	Matt G.	Computer

Work Breakdown Structure – Spring 2010						
Task	**Activity**	**Description**	**Deliverable / Checkpoints**	**Duration (Weeks)**	**People**	**Resources**
S1.0	Parts assembly & Testing	Assemble all parts and verify they work correctly	Working modules and test data	1/11 - 3/21	M,M,T,T	Various digital and general tools
S1.1	I/O System	Create and test interface between user and game	Receives all inputs and outputs all text correctly	1/11 - 2/10	Matt L., Tim	ELVIS unit
S1.1.1	Keypad	Create and test a keypad circuit for user input	Working keypad that accepts all inputs correctly	1/11 - 1/25	Matt L.	ELVIS unit
S1.1.2	LCD	Connect and test LCD screen with the microcontroller	Working LCD screen that outputs all text correctly at the appropriate time	1/20 - 2/10	Tim	ELVIS unit
S1.2	Microcontroller	Create and test code for system	Microcontroller is integrated with all other systems	1/11 - 3/21	Tim	Programmer, Computer
S1.3	LED Array	Create and test LED circuitry for upper display	Array of LEDs that are all visible when lit in a well-lit room	1/25 - 3/10	Matt L.	ELVIS unit
S1.4	Digital Logic	Create and test digital logic circuitry for upper display	Circuit that allows power to go to all of the right LEDs	1/25 - 3/10	Matt L.	ELVIS unit
S1.5	Power Supply	Build and test voltage control circuit	Working module that steps down the voltage and current to the correct values	1/20 - 2/17	Matt L.	ELVIS unit
S1.6	Ball Placement System	Build and test device to place balls	Working module and test data	1/15 - 3/21	M,M, Tatiana	Machine equipment, ELVIS unit, Computer, General tools
S1.6.1	Movement System	Build and test the motor and rail system	System of motors, gears, and rails that successfully translates the drive train to the correct location	1/27 - 3/21	Matt G.	Machine equipment, SolidWorks, General tools
S1.6.2	Electromagnet	Build and test magnetic device to pick up and drop balls	Fully functional electromagnet	1/15 - 2/15	Matt L.	ELVIS unit
S1.6.3	Electromagnet Controller Circuit	Create and test electromagnet controller circuit	Circuit that allows power to go to the electromagnet when a signal is received	1/15- 2/15	Matt L.	Elvis unit

Work Breakdown Structure – Spring 2010 (continued)						
Task	**Activity**	**Description**	**Deliverable / Checkpoints**	**Duration (Weeks)**	**People**	**Resources**
S1.6.4	Ship Sensor	Build and test Plunger to sense ship pieces on the lower display of game	Five ship pieces and a push button that sends a high signal when pressed	2/15 - 3/21	Tatiana	Machine equipment, SolidWorks, General tools
S1.7	Board Etching	Design circuit boards for final system and etch them	professionally made circuit boards	1/27 - 3/15	Matt L., Tim	Express PCB
S2.0	Programming	Write and test code for microcontroller	Functioning system code	1/11 - 4/15	Tim	Programmer, Computer
S2.1	Keypad	Write and test code for the keypad	Functioning keypad code	1/11 - 4/15	Tim	Programmer, Computer
S2.2	LCD	Write and test code for LCD screen	Functioning LCD screen code	1/11 - 4/15	Tim	Programmer, Computer
S2.3	Movement System	Write and test code for translation motor movement	Functioning translation motor movement code	1/11 - 4/15	Tim	Programmer, Computer
S2.4	Plunger Motor	Write and test code for plunger motor movement	Functioning plunger motor code	1/11 - 4/15	Tim	Programmer, Computer
S2.5	Push Button	Write and test code for push button	Functioning push button code	1/11 - 4/15	Tim	Programmer, Computer
S2.6	Electromagnet	Write and test code for the electromagnet	Functioning electromagnet code	1/11 - 4/15	Tim	Programmer, Computer
S2.8	LED Output Signals	Write and test code for turning LEDs on	Functioning LED output code	1/11 - 4/15	Tim	Programmer, Computer
S2.7	Artificial Intelligence	Write and test code for artificial intelligence	Functioning artificial intelligence code	1/11 - 4/15	Tim	Programmer, Computer
S3.0	Final Design Review	Presentation of final design	Report and Presentation	2/20 - 3/4	M,M,T,T	Computer
S3.1	Report	Write detailed report regarding the above ideas	Written report	2/20 - 3/4	M,M,T,T	Computer
S3.2	Presentation	Present ideas to faculty	Power point and verbal presentation	2/20 - 3/4	M,M,T,T	Computer
S4.0	Build Frame	Construct a frame to encase the game components	Completed Frame	2/4 - 3/20	Matt G., Tatiana	Project Lab

Work Breakdown Structure – Spring 2010 (continued)						
Task	**Activity**	**Description**	**Deliverable / Checkpoints**	**Duration (Weeks)**	**People**	**Resources**
S5.0	System Integration	Compile all modules to create prototype	Assembled project and test data	3/25 - 4/15	M,M,T,T	Project Lab
S6.0	System Testing	Run full system test	Test data	3/25 - 4/15	M,M,T,T	Project Lab
S7.0	Finalize Prototype	Verify correct operation and prepare for presentation	Completed Prototype	4/5 - 4/29	M,M,T,T	Project Lab
S8.0	Project Readiness Review	Presentation of project prototype	Report and Presentation	4/10 - 4/29	M,M,T,T	Computer
S8.1	Report	Write detailed report regarding the project	Written report	4/10 - 4/29	M,M,T,T	Computer
S8.2	Presentation	Present project to faculty	Power point and verbal presentation	4/10 - 4/29	M,M,T,T	Computer
O4.0	Documentation	Keep logs of work and research	Engineering notebooks	1/1 - 4/29	M,M,T,T	Computer, Notebooks
O5.0	A3 Status Reports	Bimonthly reports on current project status	Presentation of status and current progress	1/11 - 4/29	M,M,T,T	Computer
O6.0	Time Management	Keeping to a schedule	Keeping on schedule	1/11 - 4/29	Matt G.	Computer

Estimated Cost of Supplies			
Item	**Possible Vendor**	**Cost**	**Date of Estimate**
Latches	The Electronic Goldmine	$20.00	10/12/2009
Transformers	Honeywell	$10.00	10/12/2009
Multiplexer		$15.00	10/12/2009
Resisters	Radio Shack	$8.00	10/12/2009
Diodes	Radio Shack	$8.00	10/12/2009
Voltage Regulators	Radio Shack	$8.00	10/12/2009
Wire	Radio Shack	$20.00	10/12/2009
Professional etching board		$60.00	10/12/2009
Non-professional etching boards		$30.00	10/12/2009
Steel balls	McMaster-Carr	$33.00	10/5/2009
Motors	Robot Shop	$70.00	10/5/2009
LEDs	Electronix Express	$30.00	10/5/2009
Microcontroller	Microchip / Schmartboard	$50.00	10/5/2009
Materials for frame	McMaster-Carr	$200.00	10/5/2009
Movement supplies	McMaster-Carr	$50.00	10/5/2009
Push button	All Electronics Corporation	$5.00	10/5/2009
Keypad		$20.00	10/5/2009
LCD screen	Crystal Fontz	$25.00	10/5/2009
Miscellaneous		$188.00	10/5/2009
Total		**$850.00**	

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Senior Design 420 / 421

Gantt Chart -Fall 2009-
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Single Player Against Machine BAttleship Game

TIMELINE / SCHEDULE FALL 09'

Tasks		September				October				November					December		
		6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20
F1.0	**Final Requirements Specification**																
F2.0	**Overall System Design**																
F2.1	Functional Decomposition Level 2																
F2.3	Block Diagrams																
F2.4	Sub-Function Requirements																
F3.0	**I/O System Design**																
F3.1	Keypad Design																
F3.2	LCD Interface Design																
F4.0	**Microcontroller Selection**																
F5.0	**LED Array Design**																
F6.0	**Digital Logic Design**																
F7.0	**Power Supply Design**																
F8.0	**Ball Placement System**																
F8.1	Movement System Design																
F8.2	Electromagnet Design																
F8.3	Ship Sensor Design																
F9.0	**Frame Design**																
F10.0	**Parts Selection and Purchase**																
F11.0	**System Design & Project Plan**																
F11.1	Report																
F11.2	Presentation																
F12.0	**Interim Design**																
F12.1	Report																
F12.2	Presentation																
O1.0	**Documentation**																
O2.0	**A3 Reports**																
O3.0	**Time-Management**																

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Senior Design 420 / 421

Gantt Chart -Spring 2010-
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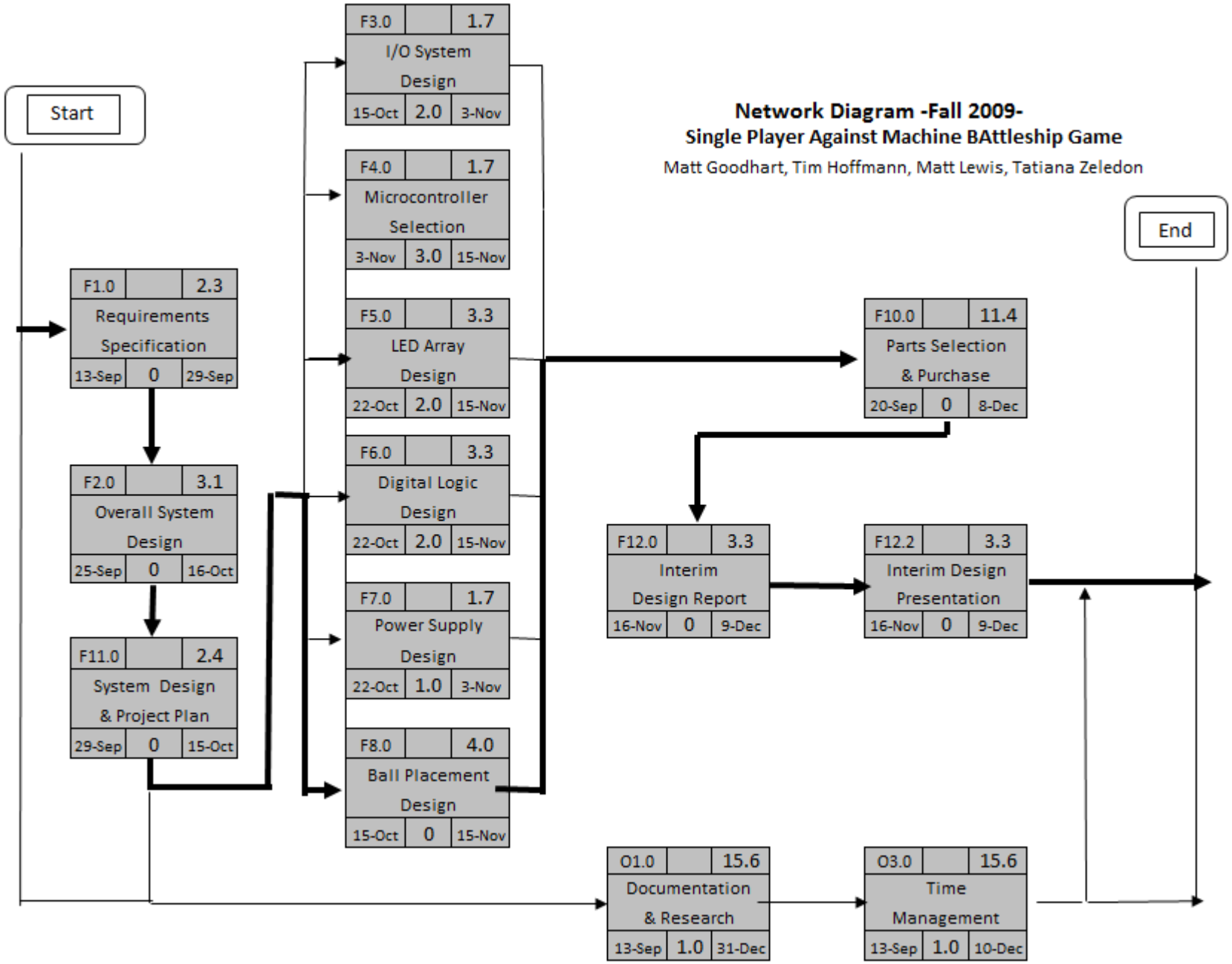
Single Player Against Machine BAttleship Game

TIMELINE / SCHEDULE SPRING 10'

Tasks		January				February				March				April				May	
		11	17	24	31	7	14	21	28	7	14	21	28	4	11	18	25	2	9
S1.0	**Parts Assembly and Testing**																		
S1.1	I/O System																		
S1.1.1	*Keypad*																		
S1.1.2	*LCD*																		
S1.2	Microcontroller																		
S1.3	LED Array																		
S1.4	Digital Logic																		
S1.5	Power Supply																		
S1.6	Ball Placement System																		
S1.6.1	*Movement System*																		
S1.6.2	*Electromagnet*																		
S1.6.3	*Electromagnet Controller Circuit*																		
S1.6.4	*Ship Sensor*																		
S1.7	Board Etching																		
S2.0	**Programming**																		
S3.0	**Final Design Review**																		
S3.1	Report																		
S3.2	Presentation																		
S4.0	**Build Frame**																		
S5.0	**System Integration**																		
S6.0	**System Testing**																		
S7.0	**Finalize Prototype**																		
S8.0	**Project Readiness Review**																		
S8.1	Report																		
S8.2	Presentation																		
O4.0	**Documentation**																		
O5.0	**A3 Reports**																		
O6.0	**Time-Management**																		


Network Diagram -Fall 2009-
Single Player Against Machine BAttleship Game
Matt Goodhart, Tim Hoffmann, Matt Lewis, Tatiana Zeledon
Start
End
F1.0 2.3
Requirements Specification
13-Sep 0 29-Sep
F2.0 3.1
Overall System Design
25-Sep 0 16-Oct
F11.0 2.4
System Design & Project Plan
29-Sep 0 15-Oct
F3.0 1.7
I/O System Design
15-Oct 2.0 3-Nov
F4.0 1.7
Microcontroller Selection
3-Nov 3.0 15-Nov
F5.0 3.3
LED Array Design
22-Oct 2.0 15-Nov
F6.0 3.3
Digital Logic Design
22-Oct 2.0 15-Nov
F7.0 1.7
Power Supply Design
22-Oct 1.0 3-Nov
F8.0 4.0
Ball Placement Design
15-Oct 0 15-Nov
F10.0 11.4
Parts Selection & Purchase
20-Sep 0 8-Dec
F12.0 3.3
Interim Design Report
16-Nov 0 9-Dec
F12.2 3.3
Interim Design Presentation
16-Nov 0 9-Dec
O1.0 15.6
Documentation & Research
13-Sep 1.0 31-Dec
O3.0 15.6
Time Management
13-Sep 1.0 10-Dec

Network Diagram -Spring 2010-

Single Player Against Machine BAttleship Game

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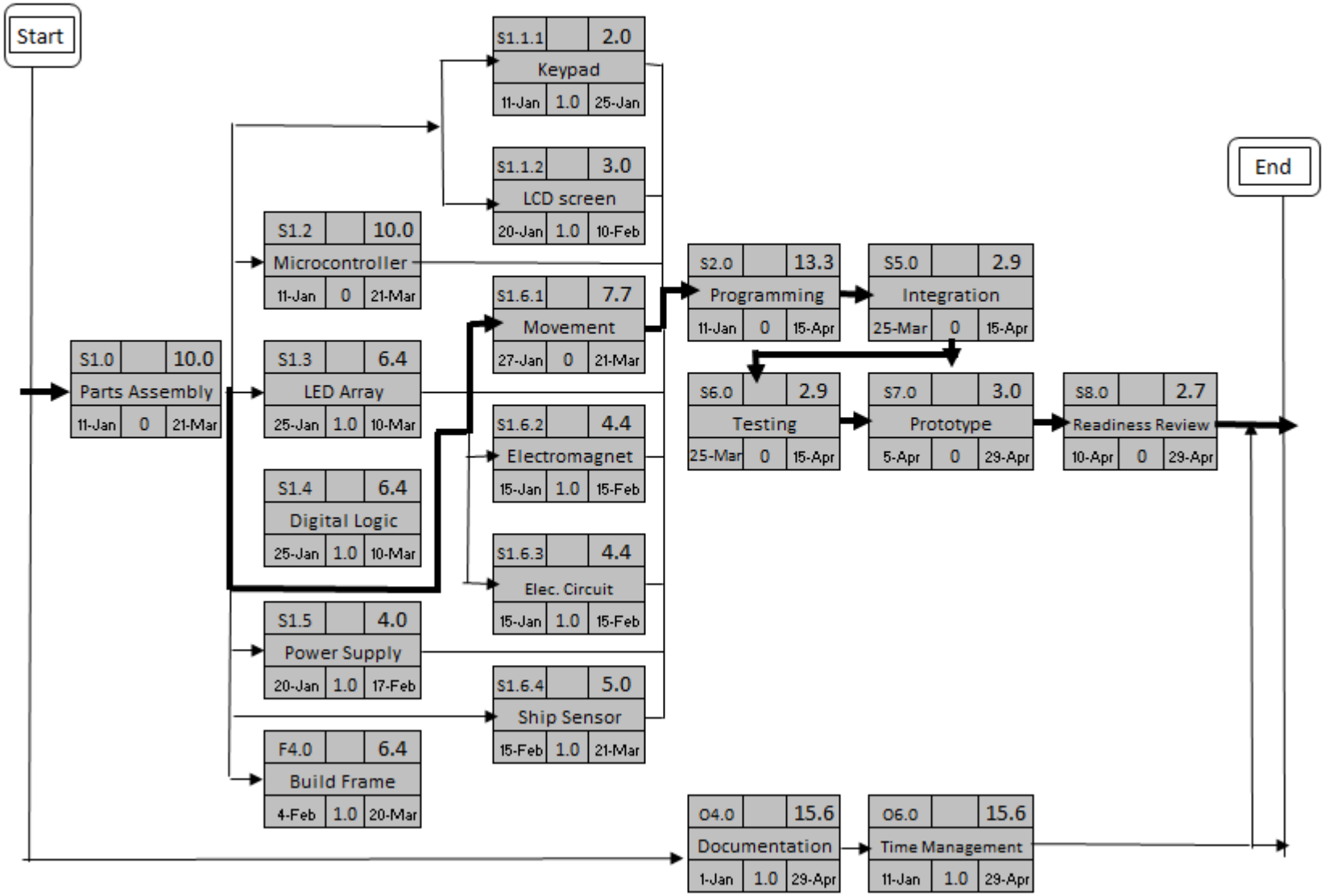

Start
S1.0 | 10.0 | Parts Assembly | 11-Jan | 0 | 21-Mar
S1.1.1 | 2.0 | Keypad | 11-Jan | 1.0 | 25-Jan
S1.1.2 | 3.0 | LCD screen | 20-Jan | 1.0 | 10-Feb
S1.2 | 10.0 | Microcontroller | 11-Jan | 0 | 21-Mar
S1.3 | 6.4 | LED Array | 25-Jan | 1.0 | 10-Mar
S1.4 | 6.4 | Digital Logic | 25-Jan | 1.0 | 10-Mar
S1.5 | 4.0 | Power Supply | 20-Jan | 1.0 | 17-Feb
F4.0 | 6.4 | Build Frame | 4-Feb | 1.0 | 20-Mar
S1.6.1 | 7.7 | Movement | 27-Jan | 0 | 21-Mar
S1.6.2 | 4.4 | Electromagnet | 15-Jan | 1.0 | 15-Feb
S1.6.3 | 4.4 | Elec. Circuit | 15-Jan | 1.0 | 15-Feb
S1.6.4 | 5.0 | Ship Sensor | 15-Feb | 1.0 | 21-Mar
S2.0 | 13.3 | Programming | 11-Jan | 0 | 15-Apr
S5.0 | 2.9 | Integration | 25-Mar | 0 | 15-Apr
S6.0 | 2.9 | Testing | 25-Mar | 0 | 15-Apr
S7.0 | 3.0 | Prototype | 5-Apr | 0 | 29-Apr
S8.0 | 2.7 | Readiness Review | 10-Apr | 0 | 29-Apr
O4.0 | 15.6 | Documentation | 1-Jan | 1.0 | 29-Apr
O6.0 | 15.6 | Time Management | 11-Jan | 1.0 | 29-Apr
End

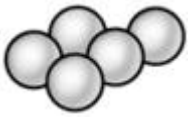
Appendices

Appendix A – Budget References

McMaster-Carr

Steel

This product matches all of your selections.



Part Number: 9528K24	$14.01 per Pack of 100
Material	Bearing-Quality Aircraft-Grade E52100 Alloy Steel
Alloy	E52100
Shape	Balls
Diameter	1/2"
Diameter Tolerance	±.0001"
Tolerance	Standard
Temper/Condition	Hardened, Quenched, Tempered
Hardness	Rockwell C60-C67
Yield Strength	295,000 psi
Grade	25
Specifications Met	American Society for Testing and Materials (ASTM)
ASTM Specification	ASTM A295
WARNING	Hardness and yield strength are not guaranteed and are intended only as a basis for comparison.

2 Packs of 100 for a total of $33.77.

From Robot Shop USA

Soyo 6V 0.8A 36oz-in Unipolar Stepper Motor

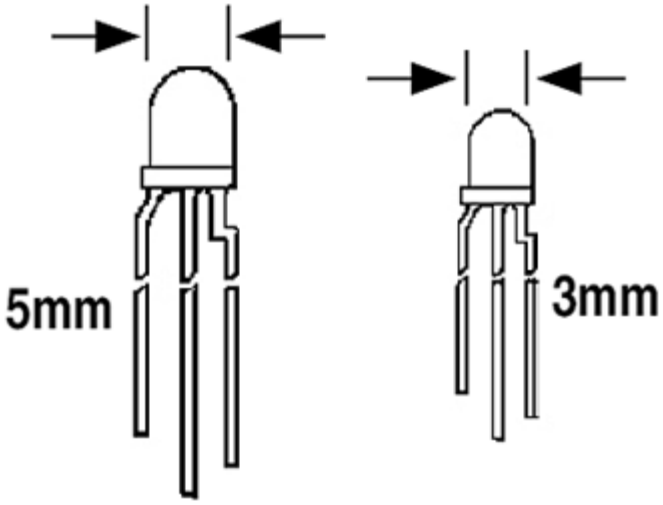
Price for one: $19.99. We bought 3 for a total of $66.09.

Soyo SY42STH38-0806A Unipolar Stepper Motor
ÅVoltage: 6vdc
ÅResolution of 1.8 degrees/step
ÅTorque of 36 oz/inch
ÅPrecision of ±5%

Professional and very high precision stepper motor. An even higher precision can be achieved (0.9 degrees/step) by using "half step mode" on the Active Robots Easy-Step 3000 stepper motor controller (RB-Act-01, RB-Act-02, RB-Act-03, RB-Act-04, RB-Act-06).

Electronix Express

Dual Color LED

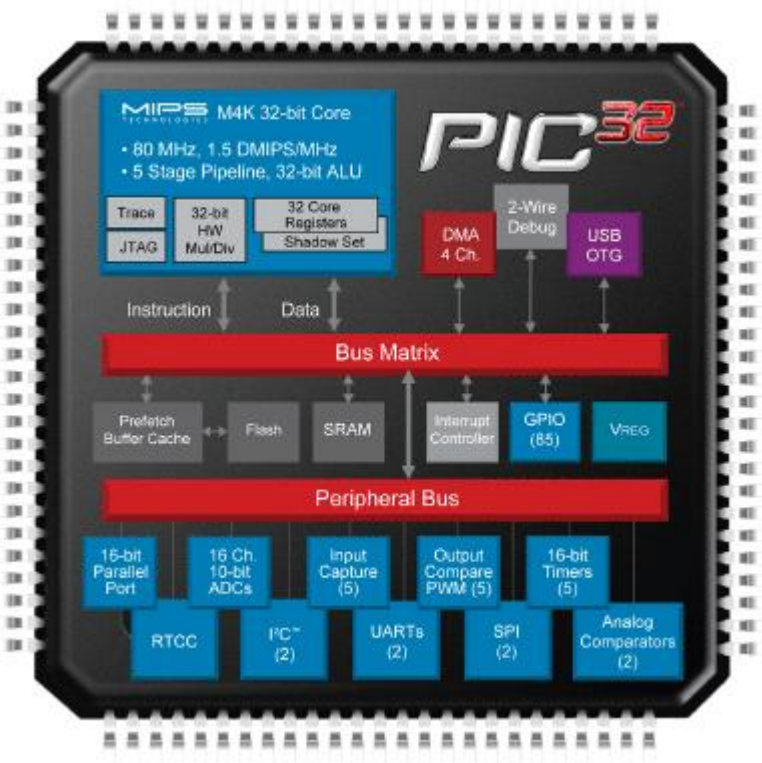


Part No.	Description	Size	1-9	10+
08LEG3392	Red/Green	5mm	$0.25	$0.20
08LYG3392	Yellow/Green	5mm	$0.25	$0.20
08L3015EGW	Red/Green	3mm	$0.25	$0.20
08L3015YGW	Yellow/Green	3mm	$0.25	$0.20

- White diffuse lens.
- Two different colors depending on leads used (Red or Green)
- 170 degree viewing angle.
- 25 mA
- 10 mCa
- 5 mm diameter
- part no. 08LEG3392
- price: $0.20 per LED (If purchasing 10 or more)
- Website: http://www.elexp.com/opt_3392.htm

From Microchip - Microprocessor

Parameter Name	Value
Family	PIC32MX4xx
Max Speed MHz	80
Program Memory Size (KB)	128
RAM (KB)	32
DMA Channels	4
SPI™	2
I²C™ Compatible	2
A/D channels	16
Max A/D Sample Rate	1000
Input Capture	5
Output Compare/Std. PWM	5
16-bit Digital Timers	5
Parallel Port	PMP16
Comparators	2
Internal Oscillator	8 MHz, 32 kHz
RTCC	Yes
I/O Pins	85
Pin Count	100



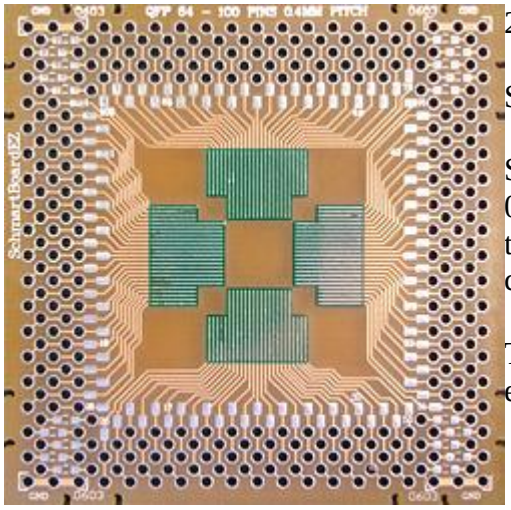
From Microchip

Microprocessor # dsPIC30F6015

Parameter Name	Value
Architecture	16-bit
CPU Speed (MIPS)	30
Memory Type	Flash
Program Memory (KB)	144
RAM Bytes	8,192
Temperature Range	C -40 to 125
Operating Voltage Range (V)	2.5 to 5.5
I/O Pins	52
Pin Count	64

Cost: $9.94

From SchmartBoards



202-0014-01

SchmartBoard|ez QFP 64-100 Pins, 0.4mm Pitch

Support 64-100 pins QFP, TQFP, PQFP package IC with 0.4mm pitch, 20 pieces of 0603 package, and some though-hole passive components. 6 ground holes are connected a copper plane on the bottom side.

This product utilizes the "EZ" technology to assure fast, easy, and flawless hand soldering

From All Electronics Corporation

SPDT MOM. PUSHBUTTON, PC MOUNT

CAT# PB-157

Apem # TP32, Miniature S.P.D.T momentary pushbutton switch. Right-angle, vertical pc mounting. Removeable 0.2ò diameter black cap. 5mm diameter, flatted plain bushing. Single pc mounting pin o front of switch body. Rated 0.4 VA 20V max.

Cost: $0.40

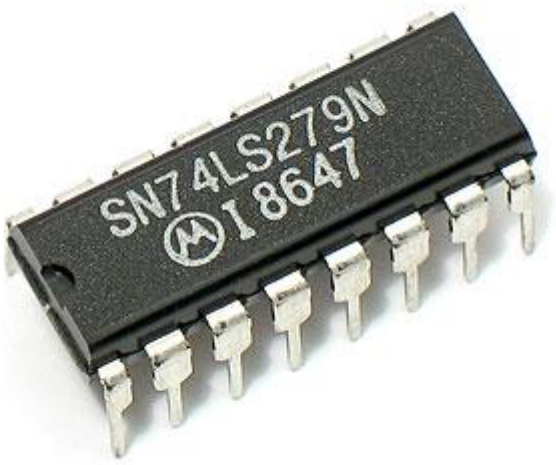
From Crystalfontz

CFAH1602D-YTI-ET
Parallel Character LCD 16x2, RoHS Compliant, Yellow/Green LED Backlight, FSTN Negative, Transmissive -20°C - +70°C 6:00

Cost: $25.00

The Electronic Goldmine

74LS279 Quad S-R Latch



Item Number : G12600

Unit Price: $0.29

Quantity 1

BUY NOW ADD TO WISH LIST

Refer this page to a friend

Detailed Description

The 74LS279 consists of four individual and independent Set-Reset Latches with active low inputs. Two of the four latches have an additional S input ANDed with the primary S input. A LOW on any S input while the R input is HIGH will be stored in the latch and appear on the corresponding Q output as a HIGH. A LOW on the R input while the S input is HIGH will clear the Q output to a LOW. Simultaneous transition of the R and S inputs from LOW-to-HIGH will cause the Q output to be indeterminate. Both inputs are voltage level triggered and are not affected by transition time of the input data. 16 pin DIP. Actual brand may vary from picture. G12600

Found at Amazon.com

Honeywell RCA900N1008/A 16V Low Voltage Transformer

Other products by Honeywell
No customer reviews yet. Be the first.

List Price:	$11.99
Price:	**$10.61** & eligible for **FREE Super Saver Shipping** on orders over $25 or **FREE Two-Day Shipping** on orders of any size with a free trial of Amazon Prime. Details
You Save:	$1.38 (12%)

Appendix B – Requirements Specification

Single Player Against Machine BAttleship Game (SPAMBAG)

Requirements Specification

Matt Goodhart, Timothy Hoffmann, Matt Lewis, Tatiana Zeledon

OVERVIEW:

Battleship is a classic game that many people play in their childhood. Typically, it is a two player game where one person plays against another. We are recreating this game so that one person can play by themselves against an interactive computer that has a robotic piece placement device. This allows a novice player to get a feel for the rules and potentially develop and improve strategies of their own. Aside from the inputs from the player on where he/she wants to place his/her ships and target the computerôs ships, the game is hands free.

OPERATIONAL DESCRIPTION:

Our battleship game will follow all of the standard rules of the classic battleship game. There will be a user input-interface, most likely an interactive LCD screen that will prompt the user with instructions and notifications, such as when to make a move or indicate when the player sunk one of the computerôs ships. There will also be a keypad which will accept the coordinates of the playerôs moves. Beginning game play will require the player to physically place his/her ship pieces on the lower display. Once the playerôs ships have been placed, the game begins a random selection of who (player or computer) goes first. This selection will be indicated on the LCD screen. On his/her turn, the player inputs his/her move. The microprocessor then discerns if the input was a hit or miss and gives the corresponding output on the upper display. Outputs include lighting a red LED (hit) or a green LED (miss). On the computerôs turn, it makes a move, the microprocessor discerns a hit or miss, and shows its output on the lower display by placing a red (hit) or green (miss) ball via the ball manipulator into its respective spot. This process is repeated until the game is over.

DELIVERABLES:

- Userôs Manual
- Software Logic Flowchart
- Technical Drawings and Analysis of Hardware
- Schematic of Circuit with Simulation Results
- Documentation of Testing
- A Final Report
- Parts List with Budget
- Battleship Game

DRAFT USER MANUAL:

Setup:

- Remove the game from its package
- Open the lid for the game
- Plug in the power cord to a Type B NEMA 5-15 15 A/125 V grounded outlet.
- Separate the balls by color and load them into the containers.
- Turn on the game by flipping the ON/OFF switch located on the board.

Operation:

1. Physically place the ship pieces on the lower display board so that the holes in the piece correspond to holes in the board.
    - For the aircraft carrier (five cells).
    - For the battleship (four cells).
    - For the cruiser (three cells).
    - For the submarine (three cells).
    - For the destroyer (two cells).
2. Wait for the computer to choose the location of its ships as indicated by the LCD screen located in the upper display of the game.
3. If the LCD screen indicates that it is the playerôs turn, select coordinate of attack (a space on the grid you believe the computerôs ship is). If the LCD screen indicates that it is the computerôs turn, continue to step six (beginning of game only).
4. Enter the coordinate on the keypad by selecting the letter (A-J) that corresponds to the chosen location and then select a number (1-10) that corresponds to the same location.
5. Notice the LED light up which indicate that the coordinate selected in step 3 was either a hit (red) or a miss (green).
6. Wait for the computerôs turn.
7. The attack of the computer will be recorded by dropping a ball on the lower display. The ball will be red if it coincides with the location of one of your ships; it will be green if it is a miss.
8. Repeat steps three through seven until the game is completed as indicated by the LCD screen.
9. Select the option to play a new game if desired and repeat steps one through eight or turn off the device using the ON/OFF switch on the lower display.
10. Unplug the game from the outlet.

USER INTERFACE:

The user interface will consist of an ON/OFF switch that allows the system to be turned on and off. There will also be ship pieces for the user to physically place on the lower display board to indicate the location of the userôs ships. There will be a keypad that will act as an input receiver for the userôs moves and will also have keys for the player to indicate if the computer sunk a ship. Also included is an interactive LCD screen that will prompt the user when it is their turn, whether they hit or missed the computerôs ship, and other instructions throughout the gameplay.

CAPABILITIES:

- Will have artificial intelligence for the computer to choose locations close to a hit in order to sink the userôs ship. Once two hits are found, only locations along a straight line should be attempted until a sinking takes place as confirmed by the user via the keypad. When the user indicates which ship has been sunk via the keypad, the computer will determine if it hit another ship in the process. If so, the computer will continue selecting coordinates in the area until it sinks that ship. Once the computer determines that there are no more known ships in the area, it will continue selecting random coordinates of attack.
- Will be able to be operated and moved by one person.
- Will acknowledge whether the coordinate selected corresponds to either a hit or a miss by displaying a message in the LCD screen and lighting up the LED in the upper display of the game that corresponds to the coordinated selected by the user. If it is a hit the color of the LED will be red and if it is a miss it will be green.
- Will be able to setup in no more than 5 minutes.
- Will be able to place balls of different colors to different locations on the board in no more than 20 seconds per move.

TESTING:

Ball Manipulator Test / Motor Test: To test the ball manipulator and the motors, a full mechanical system test will be performed where a test program is run and tells the ball manipulator to place one ball in every possible location (A1-A10 though J1-J10) in order. The test will be considered successful if the mechanical device arrives at the correct coordinate every time and if the ball makes it to the coordinate without dropping prematurely 99 out of 100 times the movement is done. This test will be run five times and statistical analysis will be performed on the results. If the ball drops prematurely, the user can place the ball in the correct location as displayed on the LCD screen.

Portability test: To determine portability and ease of operation by one person, three volunteers not associated with the Senior Design class will move the device to a testing room where outlets are available and will follow the setup and operation as described in the userôs manual. Feedback will be gathered from the volunteers via a survey to determine if the device is portable and through observation if it is easily operated. The game will weigh no more than 22.73 kg (50 pounds) and will take up a volume no more than 1.0 m^3. The footprint of the device will be no more than 1.0 m^2 and its depth no greater than 1.0 m.

LEDs Test: To test the proper functioning of the LEDs, the program will be written so that every possible location corresponds to a hit. Then, a tester will key in values for all one hundred locations. The program will reset the board and repeat the process so that all locations correspond to a miss. Only one LED must be lit whenever a coordinate is entered and should be either green (miss) or red (hit). If only one LED lights up for each entry and corresponds to the correct color, the LED test will be considered a success. Also, there will be a question on the survey for the volunteers that asks how easily the LEDs were seen.

Artificial Intelligence Test: To test the artificial intelligence of the computer, following a hit, it must continue choosing coordinates in the immediate proximity of the hit. Once two hits are found, only locations along a straight line should be attempted until a confirmed sinking takes place. Also, if it is known that a particular ship has been sunk, the computer will not attempt to re-sink that battleship. Once sunk, the computer may choose a random location of attack based on an externally programmed algorithm. The AI will be tested by playing the game.